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ABSTRACT

Forty-eight special class educable mentally retarded (EMR) students, 9 to 12 years of age, from lower socioeconomic backgrounds were examined to determine effects of communication training and learning potential (LP) training on tasks in the Communication Test Battery (CTB) and on scores in the Raven Progressive Matrices (RPM). The Ss were assigned to the following four groups (12 Ss in each group): the communication control group, the LP trained condition group, the communication trained condition group, and the LP control condition group. Training was by paired subjects during six 1/2-hour sessions twice per week and involved increasingly complex tasks in areas of perceptual discrimination, cognitive classification, language, and roletaking. Tasks incorporated concrete stimuli and required procedural verbal analysis such as describing a picture in an array for a listener. A final task required the S to be the trainer, to explain the rules, and to guide adults through an exercise. Results showed that the communication trained group had higher mean scores than the LP trained group and the communication control group on communication skills and specific skills of perception and cognition. Also, the findings showed that communication training was effective in improving performance on the RPM even when no intervening RPM training was offered. (MC)

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There has been growing interest in the use of a verbal communication model as a language and roletaking assessment and training technique for preschool and elementary age children (Glucksberg, Krauss, and Weisberg, 1966; Heider, 1969; Fry, 1966; Flavell, 1968.) The model is one in which dyad members participate as encoder and decoder when they are visually separated from each other and each other's stimulus materials. The tasks used most often demand a visual analysis of stimulus materials (e.g., pictures or patterns) which then have to be verbally encoded to a hidden listener with an identical set of materials.

Training studies by Flavell (1968) and McCaffrey (1969) have tentatively shown that the communicative ability of children as young as five from disadvantaged backgrounds can be modified by a technique involving practice under the communication model conditions, when a variety of stimulus materials are presented in order of increasing difficulty. Specifically, these studies have shown that verbal communication patterns can be modified by programmed intervention providing practice and guidance in encoding and decoding with a peer partner. Flavell (1968) described communication as a complex skill involving four antecedent factors:

perception, cognition, language, and roletaking ability. In order for the final product - the message - to be successfully encoded, the child must perceive the stimulus correctly, analyze it on the level of meaning, covertly formulate a message about it, take into account the listener's informational needs, and convey the message in overt speech.

This study reports on the effectiveness of a communication training program for young educable mentally retarded (EMR) children. The program sought to modify not only verbal communication skills but also skills related to the antecedent factors, based on Flavell's theoretical analysis of communication. The main emphasis in this program is placed on the child's self-discovery of the optimal strategies for successful communication by making them explicit through practice and recapitulation. The child who might impulsively reach an incorrect solution sitting at his desk alone is placed in a situation where he must interact with a listener who is confused by an inadequate message, forcing the child to look, analyze, reevaluate, and formulate a new message. The program seeks to develop in the child the ability to learn and exchange ideas through verbal interaction and to lead him to internalize the principles he has learned in the communication setting and apply them covertly as he works alone.

The major purpose of the present study was to determine the effectiveness of this training program in modifying not only verbal skills but also skills related to Flavell's antecedent factors. In order to test the program's effectiveness in these areas, a battery

of tasks, which will be referred to as the Communication Test Battery, was assembled to assess level of communication, language, perception, cognition, and roletaking ability.

A second purpose of the study was to examine the effect of training on a nonverbal reasoning task (learning potential procedure in Budoff, 1972) on performance on the tasks measured by the Communication Test Battery. The learning potential procedure involves testing a child on a nonverbal reasoning task, teaching him principles relevant to solving problems on the task, and post-testing him after tuition. With the Raven Progressive Matrices (RPM) as the measure of learning potential, children psychometrically defined as EMR have been found to perform at significantly different levels on the RPM before and after two coaching sessions. Post-training scores have been shown to be highly correlated with performance on other learning tasks, such as rigidity-flexibility measures (Budoff & Pagell, 1968) and to predict educational success on a manipulative science unit (Budoff, Meskin, & Harrison, 1971). This continuing research provides evidence that LP ability is not task specific, but is a measure of general intellectual ability to learn and retain information at a conceptual level when children who have done poorly in school and on scholastic aptitude tests (IQ) are shown how to perform on nonverbal reasoning tasks.

While learning potential training has been shown to affect basic reasoning abilities, it is expected that generalization of its effects may be limited to tasks with similar configuration and response requirements. That is, a strong perceptual-cognitive set

is established by the training, which is oriented toward nonverbal perceptually based problem solving. The focus of the communication training program on verbal communication may make available different strategies appropriate to the solution of verbally related problems.

The aim of this study was to examine the effects of communication training and learning potential training on the tasks in the Communication Test Battery (CTB). The effect of communication training on RPM scores was also examined. The design of the study involved four groups, to which the children were randomly assigned. The four groups represented a communication trained and an LP trained condition and control groups for these two conditions (Figure 1).

Method

Subjects

Forty-eight children from six segregated special classes in the Worcester, Massachusetts public schools served as subjects. All subjects were psychometrically classfied as EMR. The sample included only children from lower socioeconomic status backgrounds, whose diagnosis of retardation was based on functional rather than organic or structural defects. No child in the sample had gross motor, sensory, speech, or emotional problems at a level of diagnostic significance. Chronological age ranged from 9-0 to 11-11, with a mean age of 10-3 ($\pm$ 10 months). Subjects had individual IQs ranging

from 59 to 83, with a mean IQ of 69.8 (± 11).

Test Materials

Ten measures, which comprised the Communication Test Battery (CTB), were selected as operational measures of five skills. These included communication ability and Flavell's four antecedent factors (language, cognition, perception, and roletaking ability).

Communication measures. The two measures of communication ability were (1) Communication (CC) Target, in which the subject had to describe one picture from an array of four difficult-to-discriminate pictures which the decoder had to identify, and (2) CC Series, in which the subject had to arrange four pictures in the order that "made the best sense." (The pictures followed a temporal-logical order

Language. The language measure was the Illinois Test of Psycholinguistic Ability Verbal Encoding Task (ITPA V.E.), in which the subject was asked to talk about five simple objects presented individually for one minute each.

Cognition. The two cognitive measures were based on the Sigel Object Sorting Task (Sigel & McBane, 1967). The subject was presented with eleven randomly arranged objects, and was instructed to put them together in the way he thought they went best (Sigel Grouping measure), and asked to explain the basis of his groupings (Sigel Explanation measure). The two measures provided a non-verbal measure of the child's grouping skills, and his ability to explain his groupings.

Perception. Kagan's Matching Familiar Figures (MFF) task provided three perceptual measures: (1) MFF Response Latency,

(2) MFF Number Correct, and (3) MFF Number of Errors (Kagan, 1965). (A+B) In this task the subject was required to select a picture identical to the stimulus from among six pictures on a page.

Roletaking. Two measures of roletaking ability were derived from the Board Game described by Flavell (1968). In this game, an examiner shows the subject in mime how to play the game and then asks the subject to explain verbally how to play the game to a naive examiner brought in for this purpose. The procedure and scoring system is described in detail by Flavell (1968). Two scores were derived indicating the extent of useful information conveyed by the subject: (1) Flavell Number of Different Words (Flavell DW) and (2) Flavell Game Score (Flavell GS).

This battery was administered individually, in a session lasting approximately 45 to 50 minutes. Two examiners were present, one to administer the tasks and to serve as a decoder in the communication tasks; and one to record the subject's responses and make observational notes.

The Raven Progressive Matrices (RPM [Sets A, A_B, B, 1956]) were used as the measure of learning potential (LP). Learning potential measurement involves a test-train-retest paradigm. During the training period, the child is shown how to work with the nonverbal reasoning problems. Raven Progressive Matrices were individually administered in accordance with standard instructions prior to and following training. Teaching was conducted individually and the children were taught such concepts as pattern completion, orientation in space, and 2 x 2 analogies. The child's post-

training score serves as the indicator of the child's ability (see Budoff, 1972).

Procedure

The 48 subjects were randomly assigned to four groups, representing four experimental conditions, with 12 members in each group. The four groups were balanced with respect to sex, age and IQ. The four treatment conditions are presented in Figure 1.

Insert Figure 1 About Here

The 12 students assigned to Group 1 represented the communication control group: they received the Communication Test Battery on two occasions which were separated by a three week time interval equivalent to the communication training period. No intervention took place between the two test sessions.

Group 2 represented the LP trained condition: the 12 subjects in this group received LP training but did not receive communication training. As shown in Figure 1, subjects in Group 2 first took the Communication Test Battery followed by the LP training procedure; they were retested on the RPM, and then on the Communication Test Battery. The time interval between the two administrations of the CT Battery was approximately three weeks. LP training was conducted by one trainer who worked with each subject individually for two coaching sessions lasting about twenty minutes each.

The 12 students assigned to Group 3 represented the communication trained condition: they received communication training and did not receive LP training. These subjects first took the RPM

Figure 1

Procedures for the Four Treatment Conditions

Group	Procedure
1. Communication Control	[CCT_1 - no training - CCT_2]
2. LP Trained	CCT_1 [RPM_1 - LP training - RPM_2] CCT_2
3. Communication Trained	RPM_1 [CCT_1 - CCT Training - CCT_2] RPM_2
4. LP Control	[RPM_1 - no training - RPM_2]

Groups 1, 2, and 3 were compared on the CCT Battery in five analyses presented in Table 2. Comparison of Groups 3 and 4 on the RPM is discussed in the text.

followed by the Communication Test Battery. After this initial testing, they participated in the communication training program, were retested on the CTB approximately three weeks after the first administration of the battery, and were then retested on the RPM.

Group 4 represented the LP control condition: the 12 students in this group received the RPM two times, separated by a one or two day time interval equivalent to the LP training period.

Communication Training

The communication training program was conducted by two trainers who worked with pairs of subjects for six half-hour training sessions, twice a week over a three week period. The subject pairs remained the same throughout, and training was carried out according to the communication paradigm with encoder and decoder separated by a screen. A training manual provided instructions for each lesson for the trainers, and these lessons were offered the child as he demonstrated his competence. The tasks increased in complexity and difficulty and required the child to exercise skills in the areas of perceptual discrimination, cognitive classification, language, and roletaking. Every task involved concrete stimuli, usually presented in duplicate to the encoder and decoder, but in two cases presented to them as a team working together. Every task required verbal analysis of the procedure. Initial tasks tended to be simpler; e.g., they required the subject to describe a picture in an array for a listener. A later task required the subject to draw a picture of a house, and

while he was doing so, to tell a hidden listener how to draw the same picture. A final task required the subject to take the role of a trainer, explain the rules, and guide two naive adults through a simple exercise previously mastered by that subject. All training sessions were recorded verbatim both by pencil and paper and by use of a tape recorder. The tasks were presented as games, and reinforcement was directed more toward effort than correctness of solution (see Mandelkorn, 1973).

Results

Table 1 shows the means and standard deviations of each of the four groups on age, WISC full scale IQ, and all pretest and posttest measures. The table indicates that random assignment of subjects to groups resulted in similar means on age and IQ among the four groups. Table 1 also indicates that the communication trained group had higher mean scores than the communication control group on all posttests in the Communication Test Battery except MFF errors.

Insert Table 1 About Here

In order to determine the relative impact of the communication and learning potential training procedures in improving performance on the five skills represented in the CT battery, five analyses of covariance were performed with subjects in Groups 1, 2, and 3. In each analysis, the dependent measures were posttraining scores adjusted for pretraining level on the particular task(s). Separate analyses of covariance were run for communication competence

Table 1

Means and Standard Deviations for the Four Groups on Age, WISC IQ, Communication Test Battery, and Raven Progressive Matrices

	Group							
	1. Communication control (N = 12)		2. LP trained (N = 12)		3. Communication trained (N = 12)		4. LP control (N = 12)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Age in months	122.4	10.0	122.6	8.4	122.4	9.9	122.6	9.9
WISC IQ	69.1	6.3	73.3	7.0	69.7	11.3	67.2	6.3
Communication test battery								
Communication								
CC target								
1	1.6	1.0	0.6	0.6	0.9	0.8	---	---
2	0.9	1.0	0.7	0.6	1.7	0.6	---	---
CC series								
1	4.3	2.3	3.7	3.3	2.5	2.0	---	---
2	3.4	2.6	3.5	3.9	6.7	0.6	---	---
Language								
ITPA								
1	22.8	6.5	23.5	4.8	21.6	3.1	---	---
2	24.0	4.6	24.4	7.0	26.2	4.3	---	---
Cognition								
Sigel explan.								
1	4.0	3.9	6.1	2.8	4.4	3.1	---	---
2	4.2	2.5	4.9	3.7	7.4	1.7	---	---
Sigel gpg.								
1	6.5	2.8	5.8	3.0	6.4	2.6	---	---
2	5.4	2.5	5.6	3.5	8.9	2.6	---	---
Perception								
MFF r.t.								
1	111.6	51.2	180.6	117.6	143.0	67.2	---	---
2	102.8	62.4	170.0	101.8	130.0	68.0	---	---

Table 1 (continued)

	Group							
	1. Communication control (N = 12)		2. LP trained (N = 12)		3. Communication trained (N = 12)		4. LP control (N = 12)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
MFF correct								
1	7.9	1.3	8.2	1.3	7.6	2.1	---	---
2	7.2	1.6	9.0	1.3	10.3	0.9	---	---
MFF errors								
1	14.7	3.8	13.3	5.1	14.8	3.3	---	---
2	13.8	3.6	9.4	3.0	10.8	3.7	---	---
Role-taking								
Flavell D								
1	26.1	13.1	26.7	7.0	26.8	12.4	---	---
2	27.2	9.3	21.4	3.7	28.9	0.6	---	---
Flavell GS								
1	4.0	3.3	4.7	1.6	2.3	1.6	---	---
2	3.8	1.6	3.2	3.7	6.6	3.1	---	---
RPM								
1	---	---	17.0	3.7	17.3	4.3	15.5	4.0
2	---	---	20.3	4.4	20.0	3.3	15.1	5.1

(Target and Series), the ITPA verbal encoding measure, Sigel concept sorting (two measures), MFF (three measures), and Flavell roletaking task (two measures).

In each of these analyses orthogonal polynomial contrasts were obtained for two independent variables, treatment group and RPM pretest score, both of which consisted of three levels. To permit comparison between the two training groups, the three treatment groups used in these five analyses were coded as follows: 1 = communication control, 2 = LP trained, and 3 = communication trained. The second independent variable, RPM pretest level, was trichotomized into low, middle, and high levels of initial ability. This trichotomoy was based on the frequency distribution of scores on this measure to assure that the three levels contained approximately equal numbers of subjects. Level 1 contained subjects whose pretest RPM scores were 14 or under, Level 2 scores ranged from 15 to 17, and Level 3 scores were 18 or over.

Table 2 presents the significant F ratios obtained in the five analyses of covariance on the Communication Test Battery. It can be seen from the table that both the linear and quadratic effects of the Group factor were significant on the two communication measures, CC Target and CC Series. Inspection of the adjusted posttest means indicated that the communication trained group performed better than either the LP trained or the communication control groups on both measures, and that posttest scores of the latter two groups were similar. No significant Group effect was obtained on the language measure (ITPA Verbal Encoding), indicating that neither training procedure improved performance on this task.

Insert Table 2 About Here

The significant linear effect for the Group factor on the cognitive concept sorting tasks indicated that the LP trained group performed slightly better than the communication control group, while the communication trained group scored higher than either of the other two groups on the two posttests involved. A significant linear trend was also obtained on the three MFF perception measures. In this analysis, however, the LP trained group attained posttest scores on these measures that were nearly as high as those of the communication trained group.

The significant quadratic effect for the Group factor on the two Flavell roletaking measures indicated that the LP trained group attained lower posttest scores than either the communication control or communication trained groups, with the communication trained group scoring slightly higher than the communication control group. In all five analyses on the communication test battery, no significant linear or quadratic effects were obtained on the RPM pretest factor.

In order to determine the effect of the communication training program on the Raven LP measure, a sixth analysis of covariance was performed with subjects in Groups 3 (communication trained) and 4 (LP control). In this analysis, posttest RPM score was the dependent measure, pretest RPM score was the covariate, and treatment group (two levels) was the factor. A significant group effect was obtained ($F_{(1/21)} = 8.36$, $p < .01$) which indicated that the communication trained group attained significantly higher posttest scores than the LP control group on this measure.

Table 2

Significant F-Ratios Obtained In Multivariate Analyses of Covariance[a] on the Communication Test Battery With Three Treatment Groups

Source	Dependent Measures (Posttests)[b] I Communication (2)	II Language (1)	III Cognition (2)	IV Perception (3)	V Role-Taking (2)
Group (linear)	21.261***	NS	8.553**	11.807***	NS
Group (quadratic)	6.884**	NS	NS	NS	7.831**
RPM_1 (linear)	NS	NS	NS	NS	NS
RPM_1 (quadratic)	NS	NS	NS	NS	NS
Group lin. X RPM_1 lin.	NS	NS	NS	NS	NS
Group quad. X RPM_1 lin.	NS	NS	NS	NS	NS
Group lin. X RPM_1 quad.	NS	NS	NS	NS	NS
Group quad. X RPM_1 quad.	NS	NS	NS	NS	NS

*$p < .05$

**$p < .01$

***$p < .001$

[a]Covariates in each analysis were the pretest(s) on the corresponding measure(s).

[b]Numbers in parentheses indicate the number of measures used in each analysis (see Table 1).

Discussion

The findings of this study indicated that the communication trained group scored higher than the LP trained group and the communication control group on the communication skills and in the specific skills of perception and ~~cognitive skills.~~ cognition Communication training appears to be especially effective in those areas of communication requiring verbal problem-solving and communication to a listener. In addition, communication training was effective in improving performance on the Raven learning potential measure when no intervening Raven training was offered.

With regard to effects of LP training in improving communication-related skills, it is noteworthy that posttraining scores on the perceptual measures by the LP trained group were nearly as high as those of the communication trained group. One effect of RPM LP training is on tasks requiring visual analytic perceptual search and discrimination skills such as those demanded by the MFF. The expectation that LP training would also affect the nonverbal Sigel task was not confirmed.

One question this study sought to answer was whether learning developed by communication training would transfer to a more demanding task (i.e., roletaking) in which different strategies are required. After training, the communication trained group performed only slightly higher than the communication control group on the two Flavell roletaking measures, while the LP trained group attained the lowest posttest scores. The Flavell Board Game requires a subject to internalize rules on an abstract level, and communicate them to a naive player without previous verbal explana-

tion. None of the tasks presented in the communication training sessions (sorting, serial ordering, picture production and discrimination) required the level of memory, rule generation, and transformation of nonverbal demonstration into speech that is required by the Flavell tasks. In addition, the examiners had to maintain control over the subjects' invariable and repeated attempts to manipulate the Flavell game materials to supplement their verbal explanations. The negative input necessary to inhibit this behavior evident among subjects in the communication trained and control groups may have had a general negative effect on their productivity on the task.

In general, there was a tendency for LP training to lead to a slight pre- to posttest decrease of scores on tasks requiring verbal production. It may be that the LP training established a perceptual-cognitive set which could not be successfully applied to the verbal production task, so different from nonverbal reasoning focus on the RPM.

The finding that there were no significant differences among treatment groups in the area of language indicates that the ITPA verbal encoding task (the language measure) is not sensitive to the kinds of language changes brought about by communication or LP training. The Sigel Explanation task and both communication tasks require verbalization in the context of problem-solving, and performance on all of these was significantly increased by communication training. The communication and LP training procedures were heavily oriented toward problem-solving, and they did not affect simple descriptive language in the absence of feedback, like that required by the ITPA task.

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